

Attrition Resistant Iron-Based Fischer-Tropsch Catalysts

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The Fischer-Tropsch (FT) reaction provides a way of converting coal-derived synthesis gas to liquid fuels. Since the reaction is exothermic, one of the major problems in control of the reaction is heat removal. Recent work has shown that the use of slurry bubble column reactors (SBCRs) can solve this problem. The use of iron-based catalysts is attractive not only due to their low cost and ready availability, but also due to their high water-shift activity which makes it possible to use these catalysts with low H_2 /CO ratios. However, a serious problem with use of Fe catalysts in a SBCR is their tendency to undergo attrition.

Catalyst attrition can cause activity loss, difficulty in product separation, and plugging problems of downstream filters, leading to lower product quality. In the development of attrition resistant catalysts, spray drying has been used to successfully prepare iron catalysts with significantly improved physical strength while maintaining their activity and selectivity. However, the reason for such development is as of yet not well understood. An early study from our group revealed that different sources (binder vs. precipitated) and concentrations of SiO_2 incorporated in spray-dried Fe catalysts have impacts on their attrition properties. Attrition resistance appears to be heavily affected by particle density. However, the role of precipitated silica has not been clearly understood. This presentation addresses this subject.